

AD-A014 478

SOVRAD - A DIGEST OF RECENT SOVIET  
R AND D ARTICLES. VOLUME 1, NUMBERS  
5-6, MAY-JUNE 1975

S. Hibben, et al

Informatics, Incorporated

Prepared for:

Navy Foreign Language Services  
Defense Advanced Research Projects Agency

June 1975

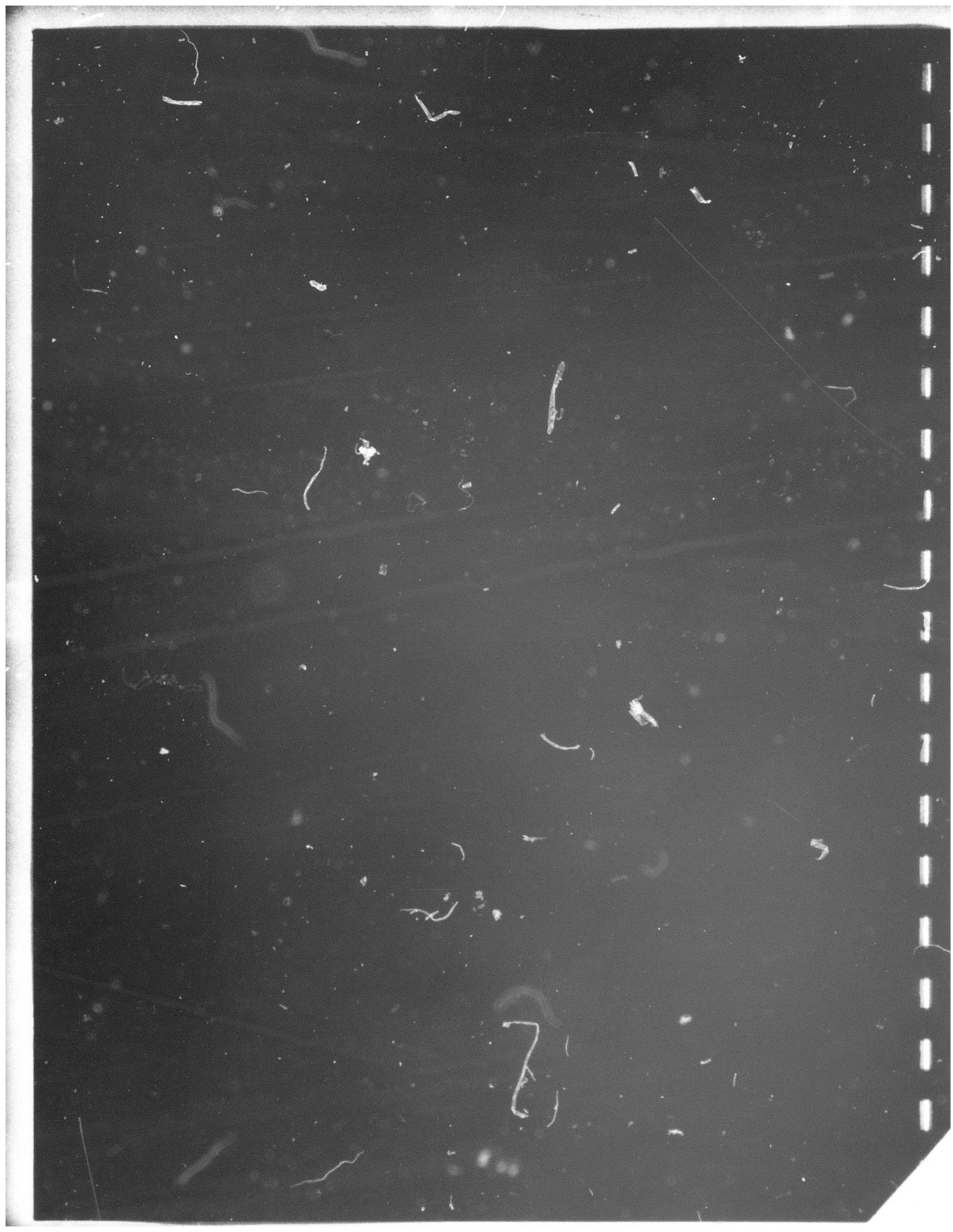
DISTRIBUTED BY:

**NTIS**

National Technical Information Service  
U. S. DEPARTMENT OF COMMERCE

260064

Reproduced by  
**NATIONAL TECHNICAL  
INFORMATION SERVICE**  
US Department of Commerce  
Springfield, VA. 22151





## UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER AD-A014 478
4. TITLE (and Subtitle) SOVRaD - A Digest of Recent Soviet R&D Articles. Vol. 1, nos. 5-6, 1975		5. TYPE OF REPORT & PERIOD COVERED Scientific . . . Interim
7. AUTHOR(s) S. Hibben, L. Boylan, J. Kourilo, B. Shresta, M. Ness		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Informatics Inc. 6000 Executive Boulevard Rockville, Maryland 20852		8. CONTRACT OR GRANT NUMBER(s) N00600-75-C-0018
11. CONTROLLING OFFICE NAME AND ADDRESS Defense Advance Research Projects Agency/TAO 1400 Wilson Blvd. Arlington, Va. 22209		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS DARPA Order No. 2790 Program Code No. L13003
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U. S. Navy Foreign Language Service 4301 Suitland Road, Bldg. 5. Washington, D. C. 20390		12. REPORT DATE May-June 1975
		13. NUMBER OF PAGES 31
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)  D D C RECEIVED SEP 3 1975 RECEIVED D		
18. SUPPLEMENTARY NOTES  Scientific . . . Interim		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Underwater Optics      Atmospheric Physics Laser Chemistry      E-Beam Interaction Geophysics Material Science Oceanography		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.  It is intended to publish this collection on a monthly basis, to continue to provide prompt coverage of numerous aspects of Soviet R&D. As an added feature, all recently acquired books will be listed as they are received. A list of source abbreviations is appended.		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

## INTRODUCTION

This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.

It is intended to publish this collection on a monthly basis, to continue to provide prompt coverage of numerous aspects of Soviet R&D. As an added feature, all recently acquired books will be listed as they are received. A list of source abbreviations is appended.

For further information the reader is invited to call Stuart Hibben or Lee Boylan at Informatics on (301)-770-3000.

### New Heat-Resistant Polymer (abstract)

The procedure is outlined for preparation of new poly(cyanamides) with enhanced resistance to deformation and heat degradation. The polymerization procedure causes formation of a regular melamine structure which is more thermostable than the isomelamine structure. Conversion of the cyanamide radicals was 98 to 99% for all poly(cyanamides) studied. All the polymers were infusible and insoluble, with dense melamine lattice structures.

TGA data show that weight loss in air starts at 400-420°C. The 9,9'-bis(4-cyanamidophenyl) fluorine-base polymer was found the most thermostable of all, losing only 15% by weight at 500°C. Data also show that the new polymers are highly heat-resistant, with 15% deformation at constant load at a temperature in the 420 to 600°C range. The polymers exhibit strong mechanical characteristics: up to 1500 kg/cm<sup>2</sup> bending strength, to 3000 kg/cm<sup>2</sup> Brinell hardness, 20,000 to 30,000 kg/cm<sup>2</sup> elastic modulus, and to 20,000 kg/cm<sup>2</sup> compressive strength. Their characteristics, together with the relative ease of synthesis, thus suggest a good use potential for these polymers. [Korshak, V. V., V. A. Pankratov, I. V. Vinogradova, N. P. Antsiferova, and D. F. Kutepov. Poly(cyanamides), the new heat-resistant polymers prepared by polycyclotrimerization of aryl-bis-(cyanamides). DAN SSSR, v. 220, no. 5, 1975, 1081-1084].

### Heterojunction Solar Cell (verbatim)

The temperature and illuminance dependence of basic parameters of p-Al<sub>x</sub>Ga<sub>1-x</sub>As-n-GaAs solar converters were studied within the 100-200°C and 1 x 10<sup>3</sup> - 40 x 10<sup>3</sup> w/m<sup>2</sup> ranges, respectively. It is shown that a high power stability versus temperature can be ascribed to a specific electrical characteristics of the converter, namely the presence of a region of low saturation feed-back currents ( $I^0 = 10^{-13}$  a/cm<sup>2</sup> at 300°K) on the forward segment of the volt-ampere characteristic, in the range of operating potentials of the device. In the range to +100°C, the power temperature gradient  $dP/PdT \leq 0.08\%/degree$ . At low temperatures, the inflection of P(T) and U<sub>x</sub>(T) curves at critical T, which is connected with a change in current flow mechanism and is typical of homogeneous Si and GaAs cells, is absent; this absence of inflection is a particular characteristic of the converters. In the range of high luminous flux, specificity of conversion is due to low feedback current and high constant coefficient of collection within the operating spectral range of the cell.

The study shows that P(E) dependence is maintained up to 40 x 10<sup>3</sup> w/m<sup>2</sup> illuminance and power saturation by luminous flux is not noticeable. It is thus possible to achieve high power densities from concentrated luminous flux on this type of heteroconverter. [Kagan, M. B., N. S. Koroleva, T. L. Lyubashevskaya, and T. A. Nuller. Photoelectric characteristics of Al<sub>x</sub>Ga<sub>1-x</sub>As-GaAs-based solar cells over broad ranges of temperature and illuminance. IN: Sb. Vses. konf. Fiz. protsessy v geteroperekhodakh, 1974. Tezisy. Kishinev, 1974, 89. (RZh Elektr, 3/75, no. 3B399). Translation)].

### Heterojunction Yellow Light Source (abstract)

A p-GaAs-pGa<sub>1-x</sub>Al<sub>x</sub>As-n-Ga<sub>1-y</sub>Al<sub>y</sub>As heterojunction emitter is reported, prepared by double epitaxy on a p-GaAs substrate with doping during epitaxy. The process temperature and composition of the lightemitters were varied, and the correlation was established between emission intensity and growth procedure. Stimulated emission peaks are distributed in the 1.93 to 1.94 eV spectral region. Electric and luminosity characteristics as well as aging data for yellow light sources on a p-p-n-heterojunction base are given and compared with the corresponding data for red light sources based on structures of the same type. [Gabriyelyan, N. K., L. N. Kumsishvili, G. M. Mirianashvili, and R. I. Chikovani. Exploratory study in preparing yellow light sources based on a GaAs-AlAs p-p-n heterostructure. IN: Sb. Vses. konf. Fiz. protsessy v geteroperekhodakh, 1974. Tezisy, Kishinev, 1974, 56. (RZhElektr, 3/75, no. 3B439)].

### Heterojunction Memory Element (verbatim)

Frozen conductivity, or the ability of materials to maintain a long-lived high level electric conductivity after illumination cutoff, is observed in certain amorphous, polycrystalline, and single-crystal semiconductors. The physical model of this phenomenon is based on the occurrence of chaotic changes in potential of the order of the forbidden gap width.

Published data on the effect of the drift-recombination barrier on properties of p-n junction type structures are extremely scarce. The purpose of the present study is to obtain a cluster-type recombination barrier in a Cu<sub>2</sub>O-CdS thin film heterojunction, and to examine the main features of its optical memory. Optical capacitance is considered to be the fundamental memory parameter. Copper clusters introduced into the Cu<sub>2</sub>O matrix during preparation of the heterojunction are the active elements. Function capacitance grows during photon illumination in the region of Cu<sub>2</sub>O intrinsic absorption, and remains elevated for a long time ( $\sim 10^5$  sec) after de-excitation. The volt-capacitance characteristics indicate that the heterojunction, although still sharp, has changed as if the concentration of majority carriers in the base material (Cu<sub>2</sub>O) were increased. This fact confirms the assumption that minority carriers are trapped by deep traps (clusters) and the space charge of the junction is rearranged. The optical memory of the system was also evidenced by long-lived relaxation of photo-emf, dark current, and forward and back resistance. The observed effects are evaluated quantitatively. [Kurmashev, Sh. D., and V. I. Andreyev. Optical memory capacity of a Cu<sub>2</sub>O-CdS heterojunction. IN: Sb. Vses. konf. Fiz. protsessy v geteroperekhodakh, 1974. Tezisy, Kishinev, 1974, 108-109. (RZh Elektr, 3/75, no. 3B427)].

### Trends in Composite Materials (abstract)

The status and applications of composite materials are outlined, and directions of further development in the field of composites are indicated. Known composites are classified, according to structure, into fibrous (fiber and whisker-reinforced), dispersion-strengthened and laminated materials, and cast eutectic alloys. Mechanical and thermomechanical characteristics as well as the main applications of the cited composite classes are summarized and compared with the corresponding characteristics of standard alloys.

The superiority of composites over conventional metallic and polymeric materials is illustrated by comparative figures of mechanical and high-temperature strength. Present and future application of composites as aircraft materials is emphasized. Development of new refractory compound-reinforced carbon composites is anticipated for use at temperatures to 2,000°C, under protective coating or in vacuum. It is believed that polymer-based composites with theoretical specific strengths of 100 km and shear modulus to 25,000 kg/mm<sup>2</sup> will find application in structural elements of present-day and future aircraft. [Trimonov, A.T., Composite materials of the future. VAN, no. 3, 1975, 37-44.]

### Patent on Carbon Vaporization (abstract)

The discovery is introduced of a new type of accelerated vaporization of carbon from liquid eutectics in contact with graphite, at the eutectic melting point. The discovery is considered particularly significant with respect to knowledge of the state of carbon atoms in eutectic melts. This knowledge is very important for metallurgy of cast iron and steel and preparation of composites by oriented crystallization of eutectic alloys. The discovery also clarifies the mechanism of artificial diamond synthesis in the presence of transition metal solvents; it is widely applicable to developing new technology for graphite-base materials with addition of carbide-forming elements, for deposition of carbon coatings, single crystal growing, etc.. [Yelyutin, V.P., V.I. Kostikov, M.A. Maurakh, N.N. Bobkovskiy, Ye. I. Neproshin, and I.A. Pen'kov. Accelerated carbon vaporization from metal carbide and carbide-carbon eutectics. Patent award no. 143. Otkr. izobr. 41/74.]



### High-Pressure Phase Transitions in Carbon and Boron Nitride (abstract)

The mechanisms of deformation of plane networks in graphite and graphitic boron nitride, BN<sub>g</sub>, are discussed in relation to the crystallographic pattern of direct phase transitions in the cited materials under high pressure.

Crystallographic projections of the possible transitions of layered-into-tetrahedral structures are interpreted in terms of atomic displacement, which requires formation of intermediate structures by either cleavage or rotation of plane layers. The only exception to this mechanism is the transition of BN<sub>g</sub> into a wurtzite structure, BN<sub>w</sub>, which proceeds directly by a layer corrugation mechanism. This mechanism explains the observation that the BN<sub>g</sub> to BN<sub>w</sub> transition occurs at the lowest pressure in shock compression and the lowest temperature under static compression, relative to the formation of all other tetrahedral C and BN phases. [Kurdyumov, A. V., The mechanism of direct phase transitions in carbon and boron nitride under high pressures. DAN SSSR, v. 221, no. 2, 1975, 322-324.]

### Highly - Refractory Concrete (verbatim)

Research data are reported on the feasibility of a high-refractory concrete based on zirconium-containing cement. The high refractivity of the concrete makes it suitable as a lining material for applications at temperatures above 2,000°. [Mel'nik, M. T., N. N. Shapovalova, and A. G. Mossur. Highly-refractory concrete. Vestnik Khar'kov politekhn in-ta, no. 98, 1974, 51-52. (RZh Kh 19M, 6/75, no. 6M85).]

### Review of Liquid Organic Semiconductor Technology (verbatim)

Results are described of lengthy experimental studies on regeneration of current carriers. Based on experimental data, conductivity of organic liquids is found to have two components. The concentration relationship of the conductivity and its dependence on electrode metals are investigated. Possibilities are shown of using regeneration in a new type of device--the regenerator, which would be suitable for application in automating of slow processes, in memory cells, switches, etc.. [Yanchenko, V. Ya. Regeneration of current carriers in organic semiconducting and dielectric liquids. IN: Tr. Dnepropetr. S-Kh. in-t, no. 27, 1974, 58-90. (RZhF, 3/75, no. 31255).]

### Probe for Organic Semiconductor Studies (verbatim)

A probe pulse generator circuit is described for studying transient electrical processes in organic semiconducting liquids. The device includes both semiconductors and electron tubes. Standard pulse technology is used in the main circuit. Using this device, a probe signal of calibrated amplitude can be applied to the test specimen in a regulated time interval. Measurements of amplitude and duration of this signal front give data on the extent and duration of electrical processes. The time lag of the probe pulse with respect to an external signal is controlled over the range from 50 msec. to 2 sec. [Kutsenko, Ye. Kh., V.A. Turenko, and S.N. Salamakha. Probe pulse generator for studying electrical processes in organic semiconducting liquids. IN: Tr. Dnepropetr. S.-Kh. in-t, no. 27, 1974, 106-109. (RZhF., 3/75, #31257).]

### New Phthalocyanine Semiconductor (verbatim)

Electrical conductivity, activation energy of conductivity, catalytic and electrocatalytic properties are investigated of hydroxyphthalocyanines (HPC) of Cu, Co, and Ni as a function of derivation conditions, parent substance, and polymerization time. These polymers, in which cyclic systems are bonded by binary association of individual rings and are separated by oxygen bridges, have comparatively high electrical conductivity and low activation energy (0.3 to 0.5 ev).

Electrical conductivity of HPC and polyphthalocyanines increases during transitions from Ni compounds to Cu compounds, and further to Co. A significant contribution to conductivity in these compounds is attributed to hydrogen bonds, which facilitate intermolecular weight (during increase of polymerization time) up to a definite limit, when a decrease in number of hydroxyl groups begins to limit the conductivity. Conductivity also depends upon the concentration ratio of O<sub>2</sub> and H<sub>2</sub> in the ambient atmosphere. It is noted that hydroxypolyphthalocyanines are effective catalysts in several oxidation processes, and show catalytic activity during electrical reduction of oxygen. [Witkiewicz, Z.R., R. Dabrowski, and W. Waclawek. Hydroxypolyphthalocyanines--new semiconductors with interesting properties. Pr. nauk. Inst. chem. organ. i fiz. PWr., no. 7, 1974, 320-328. (RZh Kh, 7/75, #7B700).]

### Irradiation Effects on Liquid Organics (verbatim)

Experimental data is described of conductivity induced by X-rays and visible light in halogen-derivatives of benzene and their solutions in diethyl ether. The change in conductivity of the considered systems due to X-radiation is shown to correlate with the presence of halogen derivatives of benzene in them. Relationships of the reversible components of X-ray conductivity, as a function of radiation intensity and applied potential difference, are linear with the exception of regions with low voltage. Visible light is found to have a partially inhibiting effect on X-ray conductivity. [Trofimova, T.N. Investigating effects of X-radiation and light on electrical conductivity of liquid organic photoconductors. IN: Tr. Dnepropetr. s.-Kh. in-t, no. 27, 1974, 91-105. (RZhF, 3/75, #31256).]

### Hydrophobic Carbon Electrodes (verbatim)

The performance of hydrophobic carbon electrodes (HCE), operating as oxygen (air) cathodes, has been studied. The HCE consisted of two layers: (1) a gas-feed layer, made up of electronically conductive noncatalytic porous material, rendered hydrophobic by water suspensions of type Hostafion TF3ID teflon; and (2) a thin active electrolyte-facing layer, made up of a catalyst (active carbon) and teflon mixture. HCE was tested in 7 normal KOH solution at room temperature in absence of pressure drop between the gas and solution. At  $i = 100 \text{ ma/cm}^2$ , initial potential differences for oxygen and air in relation to the Hg/HgO electrode were  $\sim -100$  and  $-150 \text{ mv}$ , respectively. Endurance was tested without changing the electrolyte at  $i = 30 - 200 \text{ ma/cm}^2$ . In the case of oxygen, potential at  $i = 100 \text{ ma/cm}^2$  varied from  $(-)100$  to  $(-)200 \text{ mv}$  over a period of 4000 hrs., while for air, at  $i = 50 \text{ ma/cm}^2$ , it varied from  $(-)150$  to  $(-)200 \text{ mv}$  over 6000 hrs.

The authors attribute the enhanced characteristics obtained with HCE to distinctive features of their structures. Distribution of pores along a radius, plotted with a mercury porometer, indicates that the optimum radius ( $0.03 \mu$ ) is commensurable with the average length of free molecular path, i.e., mass transfer occurs mainly by molecular diffusion (Knudsen regime) and as a result, the effect of inert impurities when using air is insignificant. It is assumed that the main cause in loss of activity during prolonged operation is the local overheating and carbonation of the electrolyte, which leads to disintegration and destruction of the electrode structure. [Iliyev, I. S. Gamburtsev, A. Kaisheva, Ye. Vakanova, Y. Mukhovski, and Ye. Budevski. Type I carbon oxygen (air) hydrophobic electrodes. Structural, physical and electrochemical characteristics of electrodes, rendered hydrophobic by teflon. IN: Iz. Otd. Khim. Nauki. Bulg. AN., v. 7, no. 2, 1974, 223-231. (RZhKh., 2/75, #2B1362).]

### Three Methods for Growing Large Ge Single Crystals (abstract)

A brief description is given comparing crystal growing results when using Czochralski, Stepanov, and Stoeber techniques for large-diameter Ge single crystals. Diameters of 60 to 80 mm were obtained with the Stepanov method, and up to 120 mm with the Czochralski method, with a resistivity variation under 15% and density dislocation to  $4 \times 10^5/\text{cm}^2$ . Using an improved Stoeber technique, the author obtained Ge crystals of 200 mm. diameter. [Smirnov, Yu. M. Growing large-diameter germanium single crystals. Tsvetnyye metall, no. 1, 1975, 52-53.]

### Two Linacs Introduced (abstract)

Data has recently been published on two heavy-current linacs developed at Tomsk Polytechnic Institute. The first is a 600 kev, 20 ka nanosecond design comprising a Marx bank, a dual pulse forming line (PFL), and an electron gun. The Marx bank is placed in a separate cylindrical stainless steel shell of 500 mm diameter and 850 mm long. Remaining elements of the accelerator (PFL, commutator, charging inductance) are located in a shell of 500 mm diameter and 1700 mm long. Overall length of the accelerator together with the gun is 3.5 m. All discharge elements of the Marx bank are located in a plexiglass tube, filled with nitrogen at 5 atm. Maximum voltage of the bank is 480 kv, shock capacitance is  $0.01 \mu\text{F}$  and wave impedance of the coaxial PFL is 32 ohm. Transformer oil is used as a dielectric in the line. Commutation of the PFL is done by a double-electron ring discharger, which is inserted between the PFL and charging inductance; the line is charged resonantly. Oscillograms of charging voltage at the PFL, voltage at the gun cathode and current pulses from the shunt and Faraday cylinder have been plotted.

The second design has a similar set of elements, carrying a 1 mev, 5 ka rating. This model uses a four-element pulse forming line with distilled water dielectric, and 20 ohms impedance. Other functional details of the commutators and electron gun are also given. This linac is designed to generate a 4 cm, 5 ka pulsed beam at not less than 30 ns per pulse. [Zherlitsyn, A.G., N.S. Rudenko, V.I. Smetanin, V.A. Tuzov, and V.I. Tsvetkov. A 600 kev, 20 ka nanosecond electron accelerator. IN: Tr. Nii yader. fiz. elektron. i avtomatiki pri Tomsk. politekhn. in-te, no. 4, 1974, 63 - 66. (RZhF, 2/75, #2V331).] [Pak, V.S., N.S. Rudenko, V.I. Smetanin, Yu. P. Usov, and V.I. Tsvetkov. A 1 Mev, 5 ka nanosecond accelerator with a water accumulator. IN: Tr. Nii yader. fiz. elektron. i avtomatiki pri Tomsk. politekhn. in-te, no. 4, 1974, 66 - 69. (RZhF, 2/75, #2V332).]



### Tonus Electron Gun (verbatim)

Construction and main parameters of the electron gun of the Tonus heavy-current electron accelerator are described. [See SCVRAD no. 2, Feb. 1975, p. 9.] The gun's insulator consists of 10 sections with gradient rings in the gaps, and has a cylindrical geometry. The geometry of the anode-cathode gap provides shielding of the insulator against direct deposition of metal during operation. A mechanism is provided for fine control of the anode-cathode gap without disturbing the vacuum. The capability of interchanging cathode points permits operation of the accelerator in the regime of electron beam generation as well as bremsstrahlung. Measuring elements including a capacitive voltage divider, Rogowsky belt and current feedback shunt are also included in the gun construction. Properties and performance are discussed in detail for different cathodes tested during accelerator operation. A description is given of the laminated anode construction for obtaining bremsstrahlung, which provides protection to the target from destructive effects of low-energy electrons. [Gleyzer, I. Z., B. V. Okulov, V. A. Tuzov, and Yu. P. Usov. Electron gun of the Tonus accelerator. IN: Nii yader. fiz. elektron. i avtomatiki pri Tomsk. politekhn. in-te. no. 4, 1974, 18 - 22. (RZhF, 2/75, #2V319).]

### E-Beam Target Study (verbatim)

Reflection of heavy-current (20 - 30 ka) electron beams from a plane metallic plate was investigated under conditions of gas focusing (pressure range  $10^{-2}$  - 2 torr). Electron energy was varied within limits of 0.6 - 1.1 Mev. Photographs of deflected beams are included. The angle at which the beam changes direction depends only slightly on incident angle:  $22^\circ$  -  $33^\circ$  for incident angle change from  $5^\circ$  -  $30^\circ$ . Relationships are presented of the beam deflection angle as a function of beam axis offset from the surface, at  $0^\circ$  incident angle, for two gas pressures in the chamber. Effects of the reflecting plate on loss of electrons in the beam were also determined. Within limits of accuracy in the measurements (10%), these effects were not detected for incident angles of  $5^\circ$  -  $35^\circ$ . [Didenko, A. N., A. I. Ryabchikov, V. A. Tuzov, and Yu. P. Usov. Reflection of powerful electron beams from a conducting surface in conditions of gas focusing. IN: Tr. Nii yader. fiz. elektron. i avtomatiki pri Tomsk. politekhn. in-te, no. 4, 1974, 43 - 46. (RZhF, 2/75, #2V325).]

#### Deceleration of a High Power E-Beam (abstract)

Characteristics of longitudinal interaction of a heavy-current relativistic electron beam with an iris waveguide have been analyzed, on the basis of the Maxwell equation for the beam-generated h.f. field  $E$  and the Vlasov equation. Wave instability in the initial phase of interaction with a monochromatic continuous beam is described in a linear approximation as a function of beam particle velocity.

In a nonlinear approximation, the beam interaction with the self-radiation field is described by a self-consistent set of equations for wave amplitude  $G$  and field harmonics phases. Numerical calculations show that in the particular case of single mode nonlinear interaction, beam particles are trapped at some point in the process by a wave, concurrently with beam bunching, which leads to stabilization. On the basis of this deduction, analytical expressions of  $G_{\max}$  and period of field pulsations are derived for the single mode nonlinear interaction, in the framework of a discrete beam model presented as a chain of charged discs. A comparison of numerical experimental data with linear theory data shows that interaction characteristics evaluated from a simplified model can be used for beam currents on the order of hundreds of amperes. [Gapanovich, V.G., and A.N. Lebedev. Interaction of a high-power relativistic beam with a decelerating structure. ZhTF, no. 4, 1975, 844 - 851.]

#### Pulse Discharge in Liquids (abstract)

Initial phase and propagation dynamics of nanosecond impulsive discharges in distilled water and hexane are reported, using electron-optical and oscillographic recording techniques. Discharge across the immersed point-plane electrode gap was triggered by voltage pulses to 400 kV with variable durations of 10 to 50 nsec. and rise time of 2 to 3 nsec. The discharge ignition time versus peak field gradient was determined for different point electrode polarities and average field intensities across the gap.

A comparison with data on nanosecond discharge in gases revealed identical effect of polarity but smaller ignition and field values in gas for the case of cathodic discharge ignition. Electrode erosion in liquids is concluded to be the consequence, not the cause of discharge ignition. Study of the discharge dynamics in liquids shows that in contrast to a gas discharge, commutation time can increase when over-voltage across the gap increases. The authors emphasize that the observed ignition and propagation characteristics of nanosecond discharge in liquids should be accounted for in design of high-voltage pulse accelerators. [Lopatin, V.V., V. Ya. Ushakov, and V.P. Chernenko. Ignition and propagation of nanosecond discharges in liquids. IVUZ Fiz, no. 3, 1975, 100 - 106.]

#### Underwater Visibility vs. Surface Roughness (abstract)

Image blurring due to underwater object shielding by a wavy water-air interface is evaluated, and possible means of minimizing the interface effect on image contrast  $K'$  are examined. The wavy surface is simulated by a spatial optical filter and its effect on image transmission is analyzed by means of the scattering function of the sea surface, the radiance distribution at the image edges, and the frequency-contrast transfer function. The zenith viewing angle  $\theta_2$ , surface roughness, object submergence depth  $h$ , and observation point altitude  $H$  are the factors taken into account in evaluation of image quality.

Plotted analytical data show that when  $h > H$ , visibility of an object is the best when the object is observed normal to the surface at  $\theta_2 \leq 25$  deg. With a normal observation direction, image contrast ( $K'$ ) can be increased by increasing  $H$ . An expression for minimizing image blurring in terms of receiver resolution and submerged target location is also given. Spatial and temporal averaging of image radiance, which is sufficient for stable imaging, is approximated from known sea roughness spectra. [Mullamaa, Yu. A. R. Effect of sea surface roughness on visibility of underwater objects. FAiO, no. 2, 1975, 199-205.]

#### Nd Laser Propagation in Water (abstract)

Nonlinear attenuation of laser pulses propagating through water was studied experimentally using the second harmonic ( $\lambda = 0.53\mu$ ) of a Q-switched Nd laser. The output beam diameter was 2.7 mm and pulse duration was 25 nsec. The peripheral portion of the output beam was screened out by a diaphragm to record only the central part, which is strongly scattered.

The experimental data show changes in pulse front shape and pulse duration, which are due to stimulated Brillouin backscattering generated at a certain threshold excitation. At an incident energy density of about  $2 \text{ j/cm}^2$ , which is twice as high as the threshold, there is saturation of the transmitted energy. Duration of the transmitted pulse decreases with the increase of incident pulse energy. It is concluded that the cited effect should be taken into account in transmission of light pulses through water when a Q-switched laser is used as a source, as exceeding the threshold impairs operation of the laser. [Bespalov, V. I., A. M. Kiselev, A. M. Kubarev, and G. A. Pasmanik. Parameters of laser pulses propagating through an aqueous medium. FAiO, no. 3, 1975, 324-326.]

### Light Scattering by Hydrosols (abstract)

Measurement data are presented on polarization characteristics of light ( $\lambda = 0.54\mu$ ) scattered by nonspherical particles of mineral or biological origin in aqueous suspensions. Clay suspensions of montmorillonite and palygorskite, as well as E. coli were selected for study, because their indices of refraction are close to those of a hydrosol and hence most closely duplicate conditions to be found in sea water. The experimental apparatus and techniques were described earlier (Kadyshevich et al., FAiO, no. 5, 1971).

Comparison of the experimental and theoretical angular dependence of all nonzero components of the scattering matrix shows that, within a 25 to 145° range of scattering angles, the matrices of the clay minerals are described adequately by the Rayleigh-Gans law. Only the scattering function of these suspensions deviates sharply from the cited law, and hence exhibits a high sensitivity to nonsphericity of the mineral particles. In contrast, the matrix of the E. coli suspensions in solution differs significantly from the Rayleigh theory, hence in the case of biological objects, application of the Rayleigh-Gans theory to calculation of scattering characteristics is not quite justified. The authors note that the matrix structure for the suspensions studied is characteristic of optically inactive scattering media, i. e. the internal anisotropy of the studied particles is not evident in polarization characteristics of light scattered by them. [Lyubovtseva, Yu. S., and I. N. Plakhina. Measuring the matrix of light scattering by a suspension of nonspherical particles. Okeanologiya, no. 1, 1975, 157-162.]

### Short-Range Optical Duplexer (abstract)

A brief description is given of the PPV-p two-way optical communication system, designed for distances to 1-1/2 kilometers under line-of-sight conditions. A semiconducting laser is used as transmitter. The complete assembly is composed of two identical systems, each including a transmitter/receiver unit, a calling device, and a power supply. Communication can be readily established with a subject at ranges to 300 m by rotating a dial by 1 to 10 degrees, thus changing the directional pattern.

The optical link can be used whenever telephone communication with moving objects is difficult, particularly during aerological and geodetic measurements; other uses suggested are in automated control systems, airports, loading of cargo vessels, and construction of multistory buildings. No other data on the system is given. [A portable communication device. Tekhnika i nauka, no. 1, 1975, 39].



### CO<sub>2</sub> Laser Reflection from Water (abstract)

An experimental study is described of CO<sub>2</sub> laser radiation reflection from natural and synthetic sea water and NaCl, MgCl<sub>2</sub>, CaCl<sub>2</sub> and MgSO<sub>4</sub> aqueous solutions. The temperature effect on radiation reflection from natural sea and distilled waters also studied. The study was considered necessary for calculations of laser radiation scattering by aerosols and hydrosols above salt water basins, better understanding of laser radiation interaction with matter, and solution of other (unspecified) important problems.

Reflection from the cited liquids was measured comparatively with that from double-distilled water, and expressed as the relative coefficient of reflection  $R_{rel}$ . Laser output power was 3 w; relative error of  $R_{rel}$  measurement was about 1%. The plotted experimental  $R_{rel}$  values of synthetic sea water and salt solutions increase almost linearly with salt concentration. This finding indicates the absence of any noticeable nonlinear effect accompanying reflection of CO<sub>2</sub> laser radiation, at up to 30 w/cm<sup>2</sup> power density.  $R_{rel}$  of all cited waters and solutions decreases when the angle of radiation incidence is increased from 7 to 10 deg. Reflectance of salt water at  $\lambda = 10.6 \mu\text{m}$  increases in the presence of MgSO<sub>4</sub> and MgCl<sub>2</sub> alone, without NaCl. Reflectance of the modulated laser radiation from Black Sea water and distilled water decreases by 2 to 5% when temperature is either increased from 20 to 50° C or decreased to 8° C. [Kropotkin, M. A., and T. Yu. Sheveleva. Reflectance of seawater and various aqueous solutions at 10.6  $\mu$ . FAiO, no. 2, 1975, 211-214]

### Ocean Light Scattering (verbatim)

Observation data from the 5th cruise of the R/V Dmitriy Mendeleyev has confirmed a previously stated assumption that the dispersion coefficient at angles  $6-\beta(6^\circ)$  [sic] best characterizes scattering properties of the sea water and is the most practical quantitative characteristic of scattering. Results of measurements in waters of the North Atlantic Drift showed that at a 10 m depth  $\beta(6^\circ) = 5.4 \text{ m}^{-1}$ ; while in the northern subtropic convergence and the North Pacific Drift,  $\beta(6^\circ) = 3.6 - 4.0 \text{ m}^{-1}$ ; at the equator and 160° West,  $4.1 - 4.6 \text{ m}^{-1}$ ; at the equator and 164° East and also in the eastern part of the region,  $5.0 - 8.5 \text{ m}^{-1}$ ; at the equator and 110°,  $\beta(6^\circ)$  reaches  $8.1 - 12$ . Water is more transparent south of the equator ( $3.0 - 4.1 \text{ m}^{-1}$ ) and in the region of 18 - 19° South, 162 - 163° West, the water is highly transparent ( $1.9 - 2.4 \text{ m}^{-1}$ ). At depths below 150 m, the water is always clearer than in the surface layers ( $\beta(6^\circ) = 1.7 + 2.8 \text{ m}^{-1}$ ), while values in the above indicated region reach  $0.46 - 0.63$ . The highest value of  $\beta(6^\circ) = 20 \text{ m}^{-1}$  has been noted in the Gulf of Panama. [Kopelevich, O. V., Yu. L. Mashtavov, V. M. Pavlov, and Yu. Ye. Ochakovskiy. Light scattering properties of sea water. IN: Sb. Gidrofiz. i gidrooptich. issled. v Atlant. i Tikhom Okeanakh. Moskva, Nauka, 1974, 113-116. (RZh Geofiz, 12/74, #12V136).]

### Ocean Water Light Scattering vs. Depth (verbatim)

Scattering matrices are given for water samples taken at various depths (in the Southern subtropics from 10 to 2000 m. Graphs are plotted for angular relationships of scattering indicatrices,  $p = -f_{12}$ , values, and components  $f_{33}$  and  $f_{43}$ . In both cases, no systematic variations with depth were noted in these relationships. [Kadyshevich, Ye. A., and Yu. S. Lyubovtseva. Scattering matrices for waters of the southern subtropic convergence zone. IN: Sb. Gidrofiz. i gidrooptich. issled. v Atlant. i Tikhom Okeanakh. Moskva, Nauka, 1974, 317-320. (RZh Geofiz, 1/75, #1V116).]

### Frequency-Contrast Characteristics of Ocean Water (verbatim)

Frequency-contrast characteristics (FCC) of an observing system operating in a turbid medium are represented by the product of the FCC of a photo detector and some function (FCC of a medium), the shape of which determines the parameters of the turbid layer. For determining dispersion coefficient  $\sigma$  of ocean water without using traditional sampling methods, during the 5th cruise of the R/V Dmitriy Mendeleyev, FCC measurements were conducted of waters in the Atlantic and Pacific Oceans at 10 stations. The equipment used for FCC measurements was designed and constructed at the Scientific Research Institute of Radiophysics (NIRFI) at Gor'kiy University. It is based on the principle of spectral analysis of scattering functions at a point.

Results of measurements to depths of 200 m showed that within limits imposed by using small-angle approximation formulas, the FCC of ocean water can be determined from the known scattering index; conversely, the scattering index can be calculated from FCC measurements. Instrument design, measurement technique, and calculations are outlined. [Bravo-Zhivotovskiy, D.M., L.B. Gordeyev, D.S. Dolin, and S.B. Mochenev. Frequency-contrast characteristics of ocean water. IN: Sb. Gidrofiz. i gidrooptich. issled. v Atlant. i Tikhom Okeanakh. Moskva, Nauka. 1974, 213-217. (RZh Geofiz, 1/75, #1V114).]

### Towed Optical Sensors (verbatim)

A system has been developed by the Institute of Oceanology of the USSR Academy of Sciences, intended for measuring the dynamics of the upper ocean layer, including turbulence pulsations. It consists of sensors for pulsation velocity (hot-wire probes), temperature (small thermoresistors), electric conductivity (ceramic coated circular electrodes) and pressure (MD-T & DDV-1A pressure transducers). An impeller-type current meter with a photoelectric revolution counter is used for measuring average current speed. During the 5th cruise of the R/V Dmitriy Mendeleyev, experiments were conducted by towing successive series of horizons down to 200 m at towing speeds of 3-12 knots. Signals from the pulsation sensor, conductivity sensor, and current meter were recorded on tape, along with time and depth measurements, with subsequent processing on a Minsk-22 computer. The experiment indicated practicability of the method, although the system still requires further improvements. [Paka, V.T. Measurements with towed sensors. IN: Sb. Gidrofiz. i gidrooptich. issled. v Atlant. i Tikhom Okeanakh. Moskva, Nauka, 1974, 9-14. (RZh Geofiz, 12/74, #12V21).]

### Two-Coordinate Doppler Current Meter (verbatim)

A Doppler current meter is described which consists of 3 identical acoustic detectors (1 transmitter and 2 receivers) positioned in one plane. The receivers are located on different sides of the transmitter and are aligned at  $45^\circ$  angles to the transmitter. The axes of the receiver directional patterns intersect at an angle of  $90^\circ$  at the point of measurement, which is 30 cm away from the transmitter. An oscillator transmits signals at 5 MHz, at an acoustic radiation power of 1 watt. Receivers record the amount of back scattered energy. The transmitter signals are converted into IF signals with a frequency shift in the receiver, which enables them to be transmitted through a single-conductor cable to a shipboard receiving unit. The mean frequency of the Doppler signals determines the average current speed and the signal spectrum yields the degree of turbulence. [Volkov, A.P., V.P. Shevtsov, and L.S. Kurbatova. Two-coordinate Doppler current meter. IN: Sb. Gidrofiz. i gidrooptich. issled. v Atlant. i Tikhom Okeanakh. Moskva, Nauka, 1974, 18-20. (RZh Geofiz, 12/74, #12V29).]

### Acoustic Velocimeter (verbatim)

A cyclic sound velocity meter is described which is based on a frequency-pulse method and was developed by the Pacific Ocean Branch of the Institute of Oceanology. The prime element is a blocking oscillator which operates in both free-running or synchronized modes. The initial generator pulse in the free-running mode excites the acoustic converter. The emitted pulse traverses a given distance in the water and hits the receiving unit where it is converted into an electric signal, which after amplification and clipping, enters a pulse-shaping stage. The signal from the shaper again triggers the oscillator, thus establishing a continuous pulsing mode. Pulse repetition frequency is determined by the transit time in water, hence the problem of determining sound velocity in water reduces to the measurement of the pulse repetition frequency. Operational and block-diagrams of the above unit are outlined. Main error sources in measurements and their reduction are examined.

This velocimeter allows determination of absolute values of sound velocity to an accuracy of 0.1 m/sec. Since the device is practically inertialess, it is possible to record fluctuation processes of any scale taking place in the water, by using frequency conversion of initial signals, which reduces the measurement error to 0.1 cm/sec (this corresponds to an accuracy of water temperature measurement of  $3 \times 10^{-4}$ ). The velocimeter was used during the 5th cruise of the R/V Dmitriy Mendeleev. Examples are given of recorded sound velocity profiles to depths of 650 m and sound velocity fluctuations in the ocean surface layer. [Varlatyy, Ye. P., and V.P. Shevtsov. Application of a frequency-pulse sound velocity meter in oceanological investigations. IN: Sb. Gidrofiz. i gidrooptich. issled. v Atlant. i Tikhom Okeanakh. Moskva, Nauka, 1974, 20-25. (RZh Geofiz, 12/74, #12V39).]

#### Towed Current Direction Meter (verbatim)

A current direction meter has been developed by the Pacific Ocean Branch of the Institute of Oceanology which continuously records the attitude of the instrument casing in the horizontal plane, and which can be used for studying currents and measuring turbulence parameters. The system consists of a wire frame which rotates about its vertical axis at 50 rev/sec. The phase of the induced emf in the coil depends on the position of the frame relative to the magnetic meridian. A photopulse sensor detects the direction coinciding with the axis of the instrument casing, and it transmits a corresponding signal, which is recorded aboard ship simultaneously with signals from the depth sensor. Measurement accuracy is within  $3^\circ$ . [Volkov, A.P., and V.P. Shevtsov. Shipboard measurement of the ocean current direction. IN: Sb. Gidrofiz. i gidrooptich. issled. v Atlant. i Tikhom Okeanakh. Moskva, Nanka, 1974, 14-17. (RZh Geofiz, 12/74, #12V28).]

#### E-Beam Destruction of Alkali Halides (abstract)

Experiments are described in support of the electron-hole mechanism of electron bombardment failure in alkali halide single crystals. KCl plate specimens 0.1 to 3.5 mm thick were bombarded with single electron pulses of varied duration in the 2 to 30 nsec range, at current densities from  $0.01 \times 10^3$  to  $1.5 \times 10^3$  a/cm<sup>2</sup>. The experimental data on failure threshold, and the absorbed electron beam energy distribution with depth, indicate that both the electron-hole and thermal shock mechanisms are involved in brittle failure.

The first mechanism is evidenced in specimens thinner than beam effective free path ( $<0.38$  mm), at the lowest constant threshold. Thermal shock evidence, e.g., surface layer cleavage, appears in thicker specimens together with a rapid decrease in the amount of absorbed energy and a sharp rise in threshold. The possibility of failure of alkali-halide single crystals via the electron-hole mechanism is thus confirmed, as postulated earlier by the authors. [Balychev, I.N., and D.I. Vaysburd, Two mechanisms of brittle failure of ionic crystals from the effect of a high-intensity electron beam. FTT, no. 4, 1975, 1236 - 1238.]



#### E-Beam Damage to GaP (abstract)

Point defects induced in n- and p- GaP single crystals by electron beam irradiation, and subsequent thermal annealing of the defects, have been studied, because of the important effect of defects on characteristics of GaP-based devices. GaP:Te and GaP:Zn crystals with  $10^{16}$  to  $10^{18}$   $\text{cm}^{-3}$  initial carrier concentration were irradiated with electrons to  $5 \times 10^{17}$   $\text{e}/\text{cm}^2$  ( $E = 1.0$  MeV) at 100 to 300° K, then annealed for 15 minutes. Conductivity measurements showed that concentration and mobility of carriers decreased after room temperature irradiation in all tested crystals, but increased after a low-temperature (100° K) irradiation with small electron doses ( $1.2 \times 10^{15}$   $\text{e}/\text{cm}^2$ ).

A stepwise recovery of conductivity and carrier mobility was observed after isochronous annealing of crystals pre-irradiated at 295° K; some difference was noted in isochronous annealing patterns between n- and p-GaP. Isothermal annealing revealed that the first anneal step in crystals of both types is described adequately by first order kinetics with activation energy = 1.5 to 2.0 eV. This fact led to the conclusion that defect migration is the mechanism of annealing. [Brailovskiy, Ye. Yu., T.D. Konozenko, and V.P. Tartachnik. Defects in electron-irradiated GaP. IN: FTP, no. 4, 1974, 769-771.]

#### Enhanced MHD Operation With $\alpha$ -Radiation (abstract)

The possibility is discussed of sustaining the electrical conductivity of the plasma in an MHD generator channel by means of ionizing the working material with  $\alpha$  particles. The amount of isotope needed is determined as a function of plasma parameters of the working substance. A ratio is found between the effective MHD generator power and reactor power of the  $\alpha$ -active isotopes, for the case in which the radiation source is the  $\alpha$ -active isotope continuously generated in the nuclear reactor by  $(n, \gamma)$  reactions. An estimate is given of cycle parameters with an MHD generator and reactor using helium and bismuth, respectively. [Kuznetsova, E.F., V.I. Povstugar, and R.V. Radchenko. Possibility of generating plasma from a working substance in an MHD-generator channel with the help of  $\alpha$ -particle irradiation. IN: Sb. Teplofizika i termodinamika. Sverdlovsk, 1974, 48-53. (RZhF, 3/75, #3G300).]

#### Oil-Fueled MHD Generation (abstract)

A brief report is given on possible use of heavy oil (mazut) combustion products as a plasma source for MHD generation. Experiments have been conducted to intensify high-temperature combustion of the mazut to enhance plasma conductive properties. Theoretical and experimental results of plasma behavior are considered. [Alikishibekova, T.M. Plasma in combustion products of mazut and its application as a working medium in MHD generators. IN: Sb. Materialy dokl. XI Nauch. sessii, posvyashch. itogam nauch-issled. rabot resp. po Koordinir. AN AzSSR probl. estestv. i obshchestv. nauk za 1973 g., 1974. Baku, Elm, 1974, 90-91. (RZh Elektrotekh, 4/75, #4F11).]

### Laser Deposition of Semiconductor Films (abstract)

An experiment is reported of sputter deposition of easily-decomposed multicomponent semiconductor thin films by laser-beam vaporization of type X-Sb-S-I glasses ( $X = \text{Ge, Sn, Pb, Cd, Cu}$ ). A ruby laser beam was focused on the glass specimen to be sputtered in a special vacuum chamber. The mass spectrum of the sputtered glass vapor products was recorded photographically.

The tabulated mass-spectrometric data show that vapors of sputtered glasses contain complex molecular species composed of additional atoms besides the elemental glass components. The composition and physical properties of the laser-sputtered films approached those of the original glasses. Resistivity of the films decreased by applying, as the X component, Ge-Cd-Sn-Pb-Cu, in that sequence. One main advantage of laser beam vaporization technique is found to be decomposition-free deposition of multicomponent thin films, which cannot otherwise be thermally deposited without decomposition. [Zakharov, V. P., I. F. Kopinets, I. M. Migolnets, I. M. Portas, and D. V. Chepur. Preparation, composition, and properties of amorphous films of complex chalcogenide semiconductors. NM, no. 4, 1975, 625-628.]

### Laser vs. Incandescent IR Imaging (abstract)

Bleaching of a latent image on an SP-1 photographic plate by exposure either to pulsed IR laser radiation or to IR radiation from an incandescent lamp was studied, to explain the earlier established quantitative difference in Herschel effect from laser radiation and the same effect from thermal radiation. A Kometa-1 semiconductor laser ( $\lambda = 850 \text{ nm}$ ), with 4w output power, emitting a continuous train of  $2 \times 10^{-7} \text{ sec.}$  pulses with a  $6 \times 10^{-5}$  to  $2 \times 10^{-2} \text{ sec.}$  repetition rate was used in the experiments. Sensitometric measurements show that an equal effect is produced by a level of laser radiation energy 4.5 times lower than the amount of thermal radiation energy, and in a time shorter by a  $10^4$  factor.

Probability calculations of the number of laser pulses required to destroy a latent image center of 14 silver atoms, by absorbing one or more light quanta per pulse, show that absorption of two quanta in a time shorter than the ionic phase of the bleaching process is the predominant mechanism of the Herschel effect. The cited calculations, in agreement with experimental data, lead to the conclusion that the Herschel effect from laser radiation involves emission of two electrons by destruction of a latent image center in a time shorter than ionic process duration, concurrently with a successive splitting of silver atoms from the center. The efficiency of thermal radiation in center destruction must be significantly lower, because the center absorbs less than two quanta in a time shorter than ionic process duration. [Fonkich, M. Ye., and K. V. Chib'sov. Quantum yield in the presence of Herschel effect. DAN SSSR, v. 220, no. 3, 1975, 655-657.]

### Photosensor Optimization (verbatim)

Design optimization of a discrete electrooptically coupled system is examined from the standpoint of possible decrease in the photo-receiver window area without losses in optical transmission. Calculations and experimental data are presented for different injection photodiodes. [Avtonomov, V.A., I.V. Varlamov, V.G. Kirpilenko, A.A. Lavrenov, and V.A. Yakovlev. Selection of photosensitive window area for the receiver of an electrooptically coupled system. Mikroelektronika, v. 3, no. 4, 1974, 354-357. (RZh Elektr, 12/74, no. 12B544).]

### Ion-Exchange Membranes for Fuel Cells (verbatim)

Decomposition dynamics of ion exchange membranes (IEM) during operation in fuel cells are reported. The membranes were obtained by sulfonation of polyethylene-polystyrene membranes and were saturated with 4N  $H_2SO_4$  solution. Tests were run for 600 and 1600 hours at room temperature, with  $i = 30-35 \text{ ma/cm}^2$  and an operating voltage of 0.7 V. Methods used were UV- and IR-spectroscopy, direct determination of exchange capacity, electric resistance and sulfogroup contents. Carbon electrodes of fuel cells were activated by platinum black. Spectroscopic analysis of the decomposition products and comparison of the same with results of 24- and 600-hour operation with 30%  $H_2O_2$  showed that the cause of IEM decomposition is the oxidation, mainly at tertiary C-atoms of polystyrene of sulfonic acid, with the formation of keto-groups and ester bridges, and electrochemical reduction of sulfogroups at the hydrogen electrode of the fuel cell. Presence of constant electric field in IEM and transfer of  $H_2O$  through IEM during operation of fuel cells expedite the separation of IEM decomposition products and decomposed polyelectrolyte. [Ceynowa, J., A. Narebska, and R. Wodzki. Membrane fuel cells. Part 2. Decomposition of ion exchange membranes, used in fuel cells. Roczn. chem., V. 48, no. 9, 1974, 1537-1543. (RZh Kh, 7/75, #7B1712).]

### Correlation of Ball Lightning with Solar Activity (abstract)

Ball lightning occurring in different parts of the world has been reviewed for the past century. The greatest number of events was found to occur in the Netherlands (339 times from 1880 to 1965). Based on meteorological data from the Netherlands, the author plots curves of ball lightning events vs. Wolf numbers for 1920 -- 1965; Wolf number  $R = K(10g + f)$ , where  $f$  = the number of spots in the solar disc,  $g$  = the number of spot groups, and  $K$  is a coefficient reflecting the observation conditions. The plot shows that the rate of ball lightning occurrence gradually increases with an increase in the intensity of solar activity, as determined by the mean annual Wolf number. The maximum rate of ball lightning repeats regularly and correlates closely with solar activity maxima.

Analyses of the relationships suggest that cosmic rays seem to be a determinant in ball lightning formation. The author sees ball lightning forming due to solar cosmic rays being focused by thundercloud electric fields onto nuclei of atmospheric xenon. Xenon nuclei then split up with nuclear energy release. Calculations show that there is adequate xenon in the atmosphere for sustaining ball lightning; the time of releasing delayed neutrons, which along with prompt neutrons cause an avalanche-type nuclear fission development, coincides with the lifetime of ball lightnings. The fact that ball lightning in central Europe frequently occurs between 40 and 60° N. lat. can hence be explained by the thunderstorm activities and intensity of solar cosmic rays in these regions. [Arabadzhi, V.I. Frequency of ball lightning occurrence. Khimiya i zhizn', no. 3, 1975, 16-17.]

### Thermonuclear Theory of Ball Lightning (verbatim)

The nature of ball lightning is interpreted in terms of energy release by the lightning owing to nuclear fusion of air component nuclei. General conditions for lightning stability are formulated and their fulfillment at high temperatures is proven. Ball lightning origin, interaction with surrounding matter, and its termination are discussed. The theory is developed in an approximation of degrees of nuclear energy-dependence of nuclear interaction cross-section. Ball lightning dimensions versus its temperature are also discussed. [Malyshev, V.A. UHF and thermonuclear hypotheses on the nature of ball lightning. IN: Tr. Taganrog radiotekhn. in-ta, no. 27, 1974, 237-243. (RZh Geofiz, 2/75, no. 2B265).]



#### Relaxation Theory of Ball Lightning (abstract)

The physical basis for a unified relaxation theory of both streak and ball lightning is described and the physical mechanism of relaxation pulses in an electrically charged lightning duct is explained. Ball lightning is treated as the visible head of a lightning stroke, rather than as a separate phenomenon, in this argument.

In the framework of relaxation theory, generation and decay of ball lightning are explained in terms of alternating periods of electromagnetic activity and calm, depending on rise and drop of electric potential across an atmospheric duct. Nonlinear propagation of e-m waves through the duct and relaxational potential drop are formulated in an approximation of the charged duct volume by a semi-ellipsoid of revolution. Self-similar expressions are derived for the charge per unit duct length, current through the duct, and the strength of the wave electric field. The propagation rate of the duct wavefront, the radius of the lightning ball, and its temperature and energy as calculated by relaxation theory are found to be in the same range of values as those observed in nature. [Kozlov, B.N. Relaxation theory of ball lightning. DAN SSSR, v. 221, no. 4, 1975, 802-804.]

#### Acoustic Peltier Effect (abstract)

A brief theoretical study has demonstrated the feasibility of developing a temperature differential across a junction of two different semiconductors by sonic excitation, rather than by the electric current used in the known Peltier effect. A simple model is assumed with an ultrasonic signal propagating normal to the junction interface. After developing a formula for junction temperature  $T_x$  as a function of upstream or downstream semiconductor temperature,  $T_0$ , the authors give a theoretical example of the effect, assuming n - InSb as one element and a semiconductor with low sonic absorption as the second element of the junction. In this example, for  $T_0 = 0.1K$  and a sonic signal of 30 MHz at  $1w/cm^2$ , a cooling of the junction by some 10% is indicated. [Gulyayev, Ya.V., and A.G. Kozorezov. Feasibility of using ultrasound to obtain reduced temperatures. ZhETF P, V. 21, no. 10, 1975, 572-574.]

## RECENT PUBLICATIONS

- Aboltin, V. Ya (ed). Strategiya imperializma i bor'ba SSSR za mir i razoruzheniye (Strategy of imperialism and struggle of the USSR for peace and disarmament). Moskva, Izd-vo Nauka, 1974, 431 p. (LC-VKP).
- Abramov, G. V., et al (eds). Issledovaniya po akustike, elektrofizike i radioelektronike. Mezhvuz. sbornik. (Studies on acoustics, electrophysics and radioelectronics). Kuybyshev, KAI, no. 2, 1974, 195 p. (KL, 17/75, #14734).
- Afinogenov, L. P., and M. S. Stenzat (eds). Avtomaticheskaya stantsiya KRAMS. (The KRAMS automatic station). Leningrad, Gidrometeoizdat, 1974, 216 p. (LC-VKP).
- Andrianov, N. A., et al (eds). Issledovaniye protsessov i sovershenstvovaniye tekhnologii v proizvodstve polimernykh materialov i stekla. Sbornik nauch. trudov. (Investigating processes and perfecting technology in manufacture of polymer materials and glass). Ivanova, Ivan. energ. in-t, 1974, 135 p. (KL, 18/75, #15819).
- Babayev, A. A. Stabilizatsiya opticheskikh priborov (Stabilization of optical devices). Leningrad, Mashinostroyeniye, Leningr. otd-niye, 1975, 188 p. (LC-VKP).
- Belyayev, A. P., Yu. S. Derendyayev, G. V. Dolbilov, et al. Fokusirovka intensivnogo elektronnoy puchka v lineynom induktsionnom uskoritele SILUND. (Focusing of an intensive electron beam in the SILUND linear induction accelerator). Dubna, OIYaI, 1974, (KL 18/75, #15611).
- Bokarev, S. P., Ye. L. Gavrilov, and M. P. Shapenkov. Osobennosti formirovaniya i svoystva polimernykh izdeliy. Obzor. (Factors in formation and properties of polymer products. Review.). Moskva, 1974, 36 p. (KLDV, 4/75, #6885).
- Borisenkov, Ye. P. (ed). Naturnyye issledovaniya po probleme vzaimodeystviya atmosfery i okeana (In situ investigations of the interaction of the atmosphere and ocean). Leningrad, Gidrometeoizdat, 1974, 182 p. (LC-VKP).
- Boyarchenkov, M. S. (ed). Magnitnyye domennyye logicheskiye i zapominayushchiye ustroystva. (Magnetic domain logic and memory devices). Moskva, Izd-vo Energiya, 1974, 175 p. (LC-VKP).
- Budnikov, N. A., and A. V. Klimenko (eds). Sbornik statey po geodezii. (Collection of papers on geodesy). Volgograd, 1973, 102 p. (LC-VKP).

- Cherenyuk, I. P. (ed.) *Khimiya i tekhnologiya polimerov. Nauch.-tekhn. Sbornik. (Chemistry and technology of polymers)*. Krasnoyarsk, Sib.TI, no. 3, 1974, 137 p. (KL, 20/75, #17347).
- Cherskiy, I. N. (ed.). *Povedeniye polimerov pri nizkikh temperaturakh (Behavior of polymers at low temperatures)*. Yakutsk, 1974, 129 p. (KL, 20/75, #17597).
- Dolbilov, G. V., V. I. Koshelev, and A. P. Sumbayev. *Vakuumnyy diod so vzryvnoy emissiyey elektronov. (Vacuum diode with explosive electron emission)*. Dubna, OIYaI, 1974, 16 p. (KL, 18/75, #15728).
- Filippov, G. F., et al (eds.). *Sovremennyye problemy optiki i yadernoy fiziki. Sbornik statey. (Current problems of optics and nuclear physics)*. Kiyev, Izd-vo Naukova dumka, 1974, 295 p. (LC-VKP).
- Fugol', I. Ya., et al (eds.). *Fizika vakuumnogo ultrafioletovogo izlucheniya. Sbornik statey (The physics of vacuum UV radiation)*. Kiyev, Izd-vo Naukova dumka, 1974, 255 p. (LC-VKP).
- Gazetova, A. M., Yu. V. Katyshev, and V. G. Makhan'kov. *Modelirovaniye na EVM gazovoy fokusirovki relyativistskogo elektronogo puchka i problema stokhastizatsii dvizheniya v nelineynykh sistemakh. (Computer modelling of gaseous focusing of a relativistic electron beam and of the problem of stochastic motion in nonlinear systems)*. Dubna, OIYaI, 1974, 10 p. (KL, 22/75, #19163).
- Glukhovskiy, B. Kh. (ed). *Voprosy dinamiki morya. Sbornik statey (Problems of ocean dynamics)*. Moskva, Gidrometeoizdat, 1974, 199 p. (LC-VKP).
- Glushkov, V. M., T. K. Vintsyuk, and V. G. Velichko. *Govoryashchiye EVM: rechevoy vvod i vyvod informatsii (Talking computers; voice input and output of information)*. Moskva, Izd-vo Znaniye, 1975, 61 p. (LC-VKP).
- Gorodinskiy, S. M., and D. S. Gol'dshteyn. *Dezaktivatsiya polimernykh materialov (Deactivation of polymer materials)*. Moskva, Izd-vo Atomizdat, 1975, 224 p. (KL, 22/75, #19300).
- Grodnev, I. I. *Napravlyayushchiye sistemy peredachi elektromagnitnykh signalov (Directional electromagnetic signal transmission systems)*. Moskva, Izd-vo. Svyaz', 1975, 79 p. (LC-VKP).
- Gurfinkel', V. S., et al. *Sistema taktil'nogo ochuvstvleniya manipulyatora i raspoznavaniye formy predmetov. (System of tactile sensitization of manipulators and recognition of the form of objects)*. Moskva, Izd-vo Nauka, 1974, 57 p. (REL, 1/2, 1975, no. 551).

- Il'in, V.A. Teleupravleniye i teleizmereniye. (Remote control and telemetry). Moskva. Izd-vo Energiya, 1974, 409 p. (RBL, 1/2, 1975, no. 1054).
- Institut sverkhтвердых материалов, Kiyev. Informatsiya - nauchnyye razrabotki - vnedreniye (The institute of superhard materials, Kiyev; information, scientific developments, introduction). Kiyev, 1974, 11 p. (KLDV, 4/75, #6815).
- Izotov, A.A. (ed). Osnovy sputnikovoy geodezii (Principles of satellite geodesy). Moskva, Izd-vo Nedra, 1974, 315 p. (LC-VKP).
- Koreneva, L.G., V.F. Zolin, and B.L. Davydov. Molekulyarnyye kristally v nelineynoy optike (Molecular crystals in nonlinear optics). Moskva, Izd-vo Nauka, 1975, 135 p. (LC-VKP).
- Malinin, S.A. Pravovyye problemy morskoy atomnoy deyatel'nosti (Legal problems of nuclear activities at sea). Leningrad, Izd-vo Leningr. un-ta, 1974, 137 p. (LC-VKP).
- Marchuk, G.I. (ed). Chislennyye metody rascheta okeanicheskikh techeniy. Sbornik nauchnykh trudov (Numerical methods of calculating ocean currents). Novosibirsk, Vychislitel'nyy tsentr, SO ANSSSR, 1974, 197 p. (LC-VKP).
- Maslov, O.D., A.G. Popeko, N.K. Skobelev, and G.M. Ter-Akop'yan. K voprosy o sushchestvo vanii v prirode sverkhtyazhelykh elementov soputstvuyushchikh gafniyu. (On the question of natural occurrence of superheavy elements with hafnium). Dubna, OIYaI, 1974, 7 p. (KL, 18/75, #15617).
- Mavlonova, M., and S.K. Karimov. Thermal conductivity and thermal quality of solid and liquid semiconductors (InSe, In<sub>2</sub>Se<sub>3</sub>, Tl<sub>2</sub>Se, TlSe, Tl<sub>2</sub>Se<sub>3</sub>). Dushanbe, 1974, 14 p. (RZhF, 3/75, #31247 DEP).
- Minakov, V.A., V.N. Pavlova, eds. Issledovaniya v oblasti sinteza i proizvodstva novykh stekol i sitallov (Studies in the synthesis and manufacture of new glasses and pyrocerams). Sbornik. Moskva, Stroyizdat, 1974, 215 p. (KL, 14/75, no. 12103).
- Mushinskiy, V.P., and M.I. Karaman. Fotoelektricheskiye i lyuminestsentnyye svoystva khal'kogenidov galliya i indiya (Photoelectric and luminescent properties of gallium and indium chalcogenides). Kishinev, Izd-vo Shtiintsa, 1975, 79 p. (KL, 22/75, #19192).

- Nevskiy, M. V. Kvazianizotropiya skorostey seysmicheskikh voln (Quasianisotropy of velocities of seismic waves). Moskva. Izd-vo Nauka, 1974, 179 p. (RBL, 1/2, 1975, #618).
- Organicheskiye poluprovodyashchiye zhidkosti (Organic semiconducting liquids). Dnepropetrovsk, 1974, 112 p. (RZhF, 3/75, #31252 K).
- Popova, S. V., et al. Vysokiye davleniya (High pressures). Moskva, Izd-vo Nauka, 1974, 168 p. (RBL, 1/2, 1975, #641).
- Puzyrev, N. N., and K. D. Klem-Musatov (eds.) Seysmicheskiye volny v slozhnopostroyennykh sredakh (Seismic waves in complex-structured media). Novosibirsk, Izd-vo Nauka, Sib. otd-niye, 1974, 109 p. (LC-VKP).
- Rudenko, O. V., and S. I. Soluyan. Teoreticheskiye osnovy nelineynoy akustiki. (Theoretical principles of nonlinear acoustics). Moskva, Izd-vo Nauka, 1975, 287 p. (LC-VKP).
- Salimova, E. A. (ed.) Svetovoye ekho: Materialy I vsesoyuz. simpoziuma po svetovomu ekho, 26 - 28 iyunya 1973 g. (Optical echo: Materials of the first All-Union Symposium on Optical Echo, June 26 - 28, 1973). Kazan', 1973, 131 p. (LC-VKP).
- Shashkov, A. G., and V. I. Tyukayev. Teplofizicheskiye svoystva razlagayushchikhsya materialov pri vvsokikh temperaturakh. (Thermophysical properties of materials decomposing at high temperatures). Minsk, Izd-vo Nauka i Tekhnika, 1975, 76 p. (LC-VKP).
- Stakhanov, I. P. Klasternaya plazma i izlucheniye sharovoy molnii (Clustered plasma and ball lightning emission). AN SSSR. In-t zemn. magnetizm, ionosfery i rasprostr. radiovoln. Preprint no. 17 (102). Moskva, 1974, 20 p. (RZhF, 1/75, #1G28).
- Termicheskiye gazovyye linzy i termogidrodinamicheskiye svetovody (Thermal gas lenses and thermohydrodynamic lightguides). In-t teplo-i massoobmena AN BSSR. Minsk, 1974, 269 p. (RZhF, 11/74, #11D790 K).
- Tikhonov, V. I., and N. K. Kul'man. Nelineynaya fil'tratsiya i kvazikogerentnyy priyem signalov (Nonlinear filtration and quasicohherent reception of signals). Moskva, Sov. radio, 1975, 703 p. (LC-VKP).
- Volkovitskiy, O. A. (ed.) Atmosfernaya optika. Sbornik statey (Atmospheric optics). Moskva, Gidrometeoizdat, Mosk. otd-niye, 1974, 184 p. (LC-VKP).
- Vsesoyuznyy simpozium po rasprostraneniyu submillimetrovykh voln v atmosfere zemli i planet. (All-Union symposium on propagation of sub-millimeter waves in the atmosphere of the Earth and planets. Proceedings). Moskva, 1974, 164 p. (LC-VKP).



- Yarembash, Ye. I., and A.A. Yelisseyev. Khal'kogenidy redkozemel'nykh elementov: sintez i kristallokhimiya (Chalcogenides of rare-earth elements: synthesis and crystal chemistry). Moskva, Izd-vo Nauka, 1975, 257 p. (LC-VKP).
- Yermakov, S.S., and N.F. Vyaznikov. Metallokeramicheskiye deta-  
li v mashinostroyenii (Metalloceramic parts in machine construction). Leningrad, Izd-vo Mashinostroyeniye, Leningr. otd-niye, 1975, 230 p. (LC-VKP).
- Zhidkov, Ye. P., and Kh. Semerdzhiyev. Programma dlya rascheta parametrov statsionarnogo samosoglasovannogo puchka relyativistskikh elektronov (Program for calculating parameters of a stationary self-consistent relativistic electron beam). Dubna, OIYaI, 1974, 16 p. (KL, 18/75, #15571).

#### ERRATUM

SOVRaD, Vol. 1, no. 4, page 15: source entry for item entitled "Designing Shipboard Electronics Against Nuclear Explosion" should read: [Loginov, I.L. Requirements for electrical and electronic equipment in ship control systems, as imposed by a nuclear explosion. Izvestiya Leningradskogo elektrotekhnicheskogo instituta, no. 153, 1974, 82-86 (RZh Vodnyy transport, no. 3, 1975, Abs. 3A435).]

# SOURCE IDENTIFICATION

DAN SSSR	-	Akademiya nauk SSSR. Doklady
FAiO	-	Akademiya nauk SSSR. Izvestiya. Fizika atmosfery i okeana
FTP	-	Fizika i tekhnika poluprovodnikov
FTT	-	Fizika tverdogo tela
IVUZ Fiz	-	Izvestiya vysshikh uchebnykh zavedeniy. Fizika
KL	-	Knizhnaya letopis'
KLDV	-	Knizhnaya letopis'. Dopolnitel'nyy vypusk
LC VKP	-	Library of Congress acquisition
NM	-	Akademiya nauk SSSR. Izvestiya. Neorganicheskiye materialy
Otkr. izobr	-	Otkrytiya, izobreteniya, promyshlennyye obraztsy, tovarnyye znaki
RBL	-	Russian Book List
RZh Elektr	-	Referativnyy zhurnal. Elektronika
RZh Elektrotekh	-	Referativnyy zhurnal. Elektrotehnika
RZh F	-	Referativnyy zhurnal. Fizika
RZh Geofiz	-	Referativnyy zhurnal. Geofizika
RZh Kh 19AB	-	Referativnyy zhurnal. Khimiya. 19AB Obshchiye voprosy khimii. Fizicheskaya khimiya
RZh Kh 19M	-	Referativnyy zhurnal. Khimiya. 19 M. Silikatnyye materialy
VAN	-	Akademiya nauk SSSR. Vestnik
ZhETF P	-	Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu
ZhTF	-	Zhurnal tekhnicheskoy fiziki